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Dated: April 25, 2003 Signature: Staci Harris (Staci Harris)

OIPE APR 2 9 2003 PATENT & TRADEMARK OFFICE

Docket No.: HO-P02314US1
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RECEIVED APR 01 2003 GROUP 1700

In re Patent Application of:
Margnus Ljungstrom, et al

Application No.: 10/062,258

Group Art Unit: 1743

Filed: January 31, 2002

Examiner: Not Yet Assigned

For: DETECTOR ARRANGEMENT FOR MICROFLUIDIC DEVICES

CLAIM FOR PRIORITY AND SUBMISSION OF DOCUMENTS

Commissioner for Patents
Washington, DC 20231

Dear Sir:

Applicant hereby claims priority under 35 U.S.C. 119 based on the following prior foreign application filed in the following foreign country on the date indicated:

Country	Application No.	Date
SWEDEN	0103118-6	09/17/2001
SWEDEN	0104461-9	12/31/2001

In support of this claim, a certified copy of the said original foreign application is filed herewith.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 06-2375, under Order No. 10108537 from which the undersigned is authorized to draw.

Dated: April 25, 2003

Respectfully submitted,

By [signature]

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PRV

PATENT- OCH REGISTRERINGSVERKET
Patentavdelningen

Intyg
C rtificat

Härmed intygas att bifogade kopior överensstämmer med de handlingar som ursprungligen ingivits till Patent- och registreringsverket i nedannämnda ansökan.

This is to certify that the annexed is a true copy of the documents as originally filed with the Patent- and Registration Office in connection with the following patent application.

(71) Sökande Gyros AB, Uppsala SE
Applicant (s)

(21) Patentansökningsnummer 0103118-6
Patent application number

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Date of filing

Stockholm, 2002-10-15

För Patent- och registreringsverket
For the Patent- and Registration Office

Hjördis Segerlund

Hjördis Segerlund

Avgift
Fee 170:-

Filed version
GY 004—SE/US

DETECTOR ARRANGEMENT FOR MICROFLUIDIC DEVICES

TECHNICAL FIELD

The present invention concerns a detector arrangement which is adapted to a microfluidic device. The microfluidic device comprises a disc with at least one essentially planar surface in which there are detection areas. The arrangement comprises a detector unit and other units enabling the detector unit to collect signals from every detection area. The signals reflect results of processes performed in the microfluidic device. The disc is primarily circular and can, if desired, be spun around its axis of symmetry to allow for the detector unit to collect signals from the various detector areas. Radial movement of the detector unit relative the disc is included.

The term "microfluidic device" means that one or more liquid aliquots are transported and processed in at least one microchannel structure within the disc. Each detector area is associated with a detection microcavity, which in turn is part of a microchannel structure.

BACKGROUND PUBLICATIONS

Similar principles have been described in a number of previous publications. See for instance:

EP 392475 (Idemitsu Petrochemical Co, Yamaji Kazutaka et al) describes an analysis apparatus comprising a rotatable disc combined with a movable detector head that can transverse the disc in radial direction. The surface of the disc is divided into sectors. In one embodiment, there is a sensitized peripheral region/band in each sector. The bands are sensitized with antibodies specific to certain antigens that occur in serum. The original antigens labeled with a fluorescent group together with a serum sample is applied to the disc at an inner position relative to the band and allowed to pass the immobilized antibodies by rotating the disc where they are complexed with the antibodies.

US5994150 (Imation Corp, Challener et al) suggests in general terms an analysis apparatus combining a disc having a plurality of regions sensitized to one or more substances (sensor disc) with a detector and a motor for rotating the disc such that each sensitized region moves proximate to the detector. The apparatus is based on surface plasmon resonance and

similar techniques utilizing optical phenomena in surfaces. Antibodies and antigens and indicator dyes may be used to sensitize the disc. The publication is scarce how to sensitize the regions and how to contact the regions with substances against which the regions are sensitized. Sensitizing substances are illustrated with enzymes, antibodies and antigens.

WO 9721090 (Gamera, Mian et al) indicates that various kinds of detector arrangements can be applied to microfluidic devices in which liquid flow is created by spinning the device.

BACKGROUND TECHNOLOGY AND THE PROBLEMS RELATED TO THE PRESENT INVENTION

The present invention belong to the field of miniaturization of processes involving sample treatment, assay protocols, chemical and biochemical synthesis etc within medicine, chemistry, biochemistry, molecular biology and the like. At present one important goal within this field is to reduce the costs related to carrying out these processes, for instance to reduce the amount of reagents needed per assay run, reduce time per assay, etc. One route has been to increase the degree of parallelity, for instance by integrating as many as possible of similar process runs in one and the same device in order to carry out all the integrated runs in parallel at the same time. This in principle includes all steps from introduction of samples aliquots and reagents (if not predispensed) to the measurement of the results of the individual runs. At present large numbers of research groups and companies are involved in developing technology that will solve the numerous problems encountered.

One problem is related to the optimal way of configuring the detector in relation to the microdevice used for running the processes while maintaining an acceptable sensitivity and reproducability. This problem may become particularly pronounced if one decides to speed up the measurement step by continuously moving the detector unit and the detection areas in a disc/chip relative to each other during the measurement operation.

Another problem is related to accomplishing an acceptable sensitivity when going down in volumes, for instance into the µl-format, such as into the nl-format, with a high degree of parallelity and maintaining an acceptable reproducibility for processes run in parallel within in the same device. This problem concerns both the processes as such and the

measurement operations because small amounts/volumes and large number of processes on a small area for the processes are also reflected in small amounts/volumes/areas for the measurement operation.

A more recent problem relates to the fact that the present assignee recently has managed to control the liquid flow in microfluidic devices containing microchannel structures in such a way that the inter-channel variation with respect to flow becomes insignificant. This progress has enabled for the assignee to quantify with a low inter-assay variation and a high sensitivity antigens in the subfemtomole range from nl-volumes by carrying out the solid phase reaction of a heterogenous sandwich immunoassay under flow conditions in nl-columns. This has raised the question about measuring the amount of immune complex in various parts of the column as function of position along the flow direction. See our copending application filed in parallel with this application on September 17, 2001 with Gyros AB as assignee and Mats Inganäs, Per Andersson as inventors "Characterization of reaction variables influencing formation and/or dissciation of affinity complexes") which is hereby incorporated by reference. A corresponding SE apppplication has also been filed on the same day. Compare also assignee's poster presented on September 17, 2001 at Proteomic Forum September 16-19, 2001, Munich, Germany

OBJECTS OF THE INVENTION.

The main object of the invention is to meet problems associated with measuring signals from detection areas in microfluidic devices and to provide improved arrangementation and improved methods that enable parallel measurements of several detection areas in the surface of a spinnable disc which is part of a microfluidic device as described herein.

A first subobject is to provide an arrangementation and a method that gives a high accuracy and reproducibility with respect to collecting radiation from the individual detection areas in the surface of a disc which is part of a microfluidic device as described herein. The same also applies for irradiation if the detection principle used requires irradiation before collection of radiation.

A second object is to manage measuring fluorescence signals from individual detection areas that are present in the surface of a disc that is part of a microfluidic device as described herein.

This objects in particular applies to measurements in discs while spinning.

LEGENDS TO THE DRAWINGS.

Figure 1 illlustrates a schematic view on arrangement of the invention and its main parts.

Figure 2 illustrates a detector head relative a disc (microfluidic device) (cross-sectional view).

Figure 3a illustrates the series of microchannel structures used in a real experiment, and figure 3b shows an enlargement of an detector area.

THE INVENTION

We have now recognized that these objects can be achieved in a microfluidic device as defined in the appended claims. Other inventive features of the present invention are apparent from the descriptive part of this specification. Accordingly the first aspect of the invention is a detector arrangement that is adapted for measuring radiation from one or more detection areas (**35a,b,c** etc in **figure 3**) in a microfluidic device (**101 in figure 1**) as discussed below. With reference to figure 1, the arrangement comprises:

(a) at least one detector unit comprising a detector head (**102**), which is capable of collecting radiation from an area of predetermined size (focal point or focal area), said area defining the dimension of a subarea (**34a**) that is part of a detector area (**35a**) and said radiation emanating specifically from a substance that possibly is present in said subarea (**34a**), and

(b) means (means I) (**103**) for holding the disc and enabling for the detector head (**102**) to transverse several subareas (**34a,b,c** etc) that are positioned in an essentially circumferential direction in at least one of said one or more detection areas (35), and

(c) means (means II) (**104**) enabling for the detector head (**102**) to transverse subareas (**34a',b',c'** etc) that are positioned in the radial direction in at least one of said one or more detection areas (35), and

(d) means (means III) (105) for recognizing the angular positions for different parts of individual detection areas (35a',b',c' etc) and of their subareas, and

(e) means (means IV) (106) for recognizing the radial positions for different parts of individual detection areas and their subareas, and

(f) a controller (107), e.g. computer with software, that controls

(i) that means I (103) and II (104) cause the detector head (102) to transverse in an essentially circular fashion over the surface of at least one annular zone of the disc where there are detector areas (35a',b',c' etc) or over part of said annular zone

(ii) that the detector head (102) successively collects radiation from individual subareas or groups of subareas in a preselected manner.

The detector unit may also comprise further detector heads.

The detector head (102) is equipped to have a capacity for detecting a particular substance in at least a subarea area (34) of a detection area (35). The detector head (102) may be equipped with a photomultiplier tube (PMT) for detecting fluorescence or chemiluminiscence, e.g., or be equipped with any suitable detecting means that is adapted for monitoring and/or recording an activity, taking place in the microcavity. This is further illustrated in figure 2 for a detector head adapted for laser induced fluorescence. The detector head (102) is supported on a frame structure (108) that is mechanically connected to a motor (109) (spinner) with a rotable shaft (110), for varying in a controlled manner the speed, e.g. between 60 –15 000 rpm. The motor and the shaft is part of means (I) that also may contain means (III) in form of an encoder (see below). The detector head (102) is controlled and guided on the frame structure (108) for linear displacement and positioning in a first plane P_1, transversely through the central axis CL of shaft (110) and running in a radial direction thereto. A drive unit (111) may be in form of a translational responder for operable for incrementally changing the position of the detector head (102) in said first radial plane P_1 for scanning radially adjacent part areas of each microcavity that is transversed whoile the disc is spinning. The drive unit is part of means II that also may contain means (IV) in form of an encoder. The drive unit (111) and and The vertical height of plane P_1 may be adjustable for focusing purposes, e.g.

Control means, for instance electronic and programmable control means (schematically illustrated by reference numeral (107) with operator's interface and software, not further disclosed, is assigned to the detector arrangement for recognizing a start/stop-position, for

identifying individual subareas in detection areas, for controlling the simultaneous rotating of the disc and the incremental displacement of the detector head (102), for collecting data from the microcavity/microcavities, and for treatment and presentation of the collected data, e.g. This control means enables that the detector can collect radiation from distinct subareas possibly with some overlap as discussed below. Typically collection of radiation is carried out with one, two or more subareas per detector area per revolution.

The disc has a home position, which is preferably placed in an outer circumferential zone outside the detection areas or some other position, which can be detected with high accuracy. The position and the circumference of each detection area are preferably allotted position coordinates relative to the home position. The home position is preferably placed in an outer circumferential zone outside the detection areas. The position coordinates of a specific spot of the surface of the disc is preferable given as the angular position relative to the home position and as the radial position relative to the circumference (or axis of symmetry).

In order to secure a high accuracy for positioning the detector head over a predetermined spot in a detection area the angular position coordinate is linked to the grade scale given by an encoder included in means I (105). This arrangement also permits a high accuracy for the collection of radiation from an intended spot, in particular if this is done while spinning the disc. In the same manner a high accuracy is also obtained for the irradiation of a spot if the detector principle used so require. A less accurate alternative is to link the collection of radiation/irradiation to the programmed spinning rate during measurement.

The total area of each detector area from which radiation is collected constitutes at least 50 % of each detector area, such as at least 80% or at least 90 % up to 100%, typically with the subareas from which radiation has been collected preferably being homogeneous distributed over a detection area and/or with or without overlap between subareas that are next to each other. The overlap between subareas that are next to each other may be ≤ 25%, such as ≤ 15% or ≤ 5%. The overlap may also be ≥ 25 %.

The design of the detector head is typically made such that the dimension of the area of predetermined size in the direction corresponding to the width of the detection area

(perpendicular to the flow direction in the underlying detection microcavity) is typically essentially equal or ≤ 1/5 such as of the ≤1/10 of said width. In the direction corresponding to the flow direction, the dimension can be considerably larger. In preferred cases the area of predetermined size is rounded with a plane of symmetry, preferably the area is essentially circular.

The design of the detector unit very much depends on the detection principle integrated into the arrangement. Typical detection principles that can be used are fluorescence, chemiluminscence, bioluminescence, radioactivity, etc. See for instance **WO 9721090** (Gamera, Mian et al), which gives an overview in relation to a microfluidic device based on a circular disc and transporting liquids by spinning. Since the microfluidic devices of the present invention typically requires detection of very low absolute amounts of substances in the detection area it is imperative in many variants of the present invention that the detection principle selected shall enable detection and quantification of substance amounts that are $\leq 10^{-12}$ mole per detection area such as $\leq 10^{-15}$ mole per detection area or even lower. With respect to fluorescence techniques, laser induced fluorescence (LIF) preferable combined with confocal technique is considered outstanding, in particular for discs made of plastic material.

The detector head may be in the form of a linear detector head that is capable of collecting light from an area in form of a straight line. This line may be of (a) the same length as the radial distance between an innermost detection area to an outermost detection area at the same angular position as this innermost detection area, or (b) the same length as the radial extension of a detection area, or (c) interrupted so that it only corresponds to the radial extension or less of detector areas that are at the same angular position, or (d) etc. In alternative (a) means II becomes an inherent part of the detector head.

Figure 2 illustrates a detector set up which is suitable for a Laser Induced Fluorescence (LIF) module constructed for quantitative measurement of fluorescence in nano-columns in the spinning discs.

A pick-up head (200) was constructed. It consisted of a laser (201) whose beam was reflected on a dichroic mirror (202) and focused onto a subarea (203) of a detector area in a

microchannel structure of interest in the disc of interest through a 5x objective (205). The epi-fluorescent light passed through the dichroic mirror and through a band-pass filter (206), optimised for the flourochrome at hand. It was focused onto a photo multiplicator tube (PMT) (207) by means of an aspheric lens (208). Piholes (209 and 210) were positioned between the entrance of the laser light and the dichroic mirror and between the PMT (207).

The microfluidic device in form of a disc (211) has a spinning axis (axis of symmetry) (212).

Microfluidic device

The microfluidic device used in the present invention comprises a large number of microchannel structures oriented in the plane of a disc. Each of the structures has one or more inlet ports, one or more outlet ports and one or more detection microcavities, and microconduits connecting these parts with each other. In each of the structures it is intended to transport aliquots of liquids that are processed in various kinds of microcavities (reaction microcavities) while they are traveling through a microchannel structure. The result of the processing is measured in one or more detection microcavities through corresponding detection areas, which are placed in either or both of surfaces of the disc. A detection microcavity may be positioned at the most downstream part of a microchannel structure to measure a final result of the process, and/or at an intermediary position to measure the result after certain process steps and/or at an early position in order to measure liquids and reagents in connection with their introduction into the structure.

The disc typically has an axis of symmetry (C_n) where n is an integer > 5 preferably ∞ (C_∞). In other words the disc is preferably circular. Once a circular disc has been selected it opens up the possibility to use spinning (centrifugal force) for driving liquid within the microchannel structure, in particular for driving liquid through a combined reaction/detection microcavity during the time period when an immobilized product is formed in the microcavity.

The term "a plurality of microchannel structures" means two, three or more microchannel structures. Typically the term "plurality" means ≥ 10, such ≥ 50 or ≥ 100 microchannel structures.

The microfluidic device may also comprise common channels connecting different structures, for instance common distribution channels for introduction of liquids and common waste channels including waste reservoirs. Common channels including their various parts such as inlet ports, outlet ports, vents etc are considered part of each of the microchannel structures they are connected to.

A port has three main functions (1) inlet for liquid, (2) outlet for liquid, and/or (3) venting to level out a possible overpressure in potential "dead-ends" of a microchannel structure and to break up a liquid flow (also called Mose's effect, see the common distribution channal described US provisional application ("A microfluidic system comprising functionalities") filed on August 28, 2001 and **WO 0146465** (Gyros AB; Andersson, Aksberg, Ekstrand). A port that is used as a vent with no intention for liquid transport will henceforth be called a vent if not otherwise specified.

The microchannel structures are covered. By this is meant that the contact with ambient atmosphere is via the inlet and outlet ports and vents.

The terms "microchannel", "microconduit" etc contemplate that a channel structure comprises one or more cavities and/or channels/conduits that have a cross-sectional dimension that is ≤ 10^3 µm, preferably ≤ 10^2 µm. The lower limit is typically significantly larger than the size of the largest reagents and constituents of aliquots that are to pass through a microchannel. The volumes of microcavities/microchambers are typically ≤ 1000 nl, such as ≤ 500 nl or ≤ 100 nl or ≤ 50 nl or ≤ 25 nl, which in particular applies to the detection microcavities. Chambers/cavities directly connected to inlet ports for liquids may be considerably larger, e.g. microchambers/microcavities intended for application of sample and/or washing liquids. Microformat means that one, two, three or more liquid aliquots that are transported within the device has a volume in the µl-range, i.e. ≤ 1000 µl such as ≤ 100 µl or ≤ 50 µl including the nl-range (nanoformat), such as ≤ 1000 nl such as ≤ 500 nl or ≤ 100 nl or ≤ 50 nl or less.

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The disc may be made from different matrials, such as plastics, glass, silicone etc. At the detector microcavity the disc should be transparent for the detection principle utilized by the detector, with preference for the complete surface area being of one and the same transparent material. From the manufacturing point of view plastic material is many times preferred because the costs for this kind of material are normally low and mass production can easily be done, for instance by replication. Typical examples are embossing, moulding etc. See for instance **WO 9116966** (Pharmacia Biotech AB, Öhman & Ekström). However, plastics may interfere with several sensitive detection principles. Plastics, for instance, have a high auto-fluorescence and therefore rules out normal fluorescence techniques in case low absolute amounts are to be measured or if the fluorescence signal has to travel trough plastic material as nearly imperative in the microfluidic devices under discussion. This points to the fact that it is important to match the material in the disc with the detection principle used. At the priority date of this specification the preferred disc material is plastic material such as polycarbonates and plastic material based on monomers structurally consisting of a polymerisable carbon-carbon double or triple bonds and saturated branched straight or cyclic alkyl and/or alkylene groups. See for instance **WO 0056808** (Gyros AB, Larsson, Ocklind and Derand) which is hereby incorporated by reference.

It is known that black plastic material, for instance containing graphite powder or carbon black, have extremely low autofluorescence. It can therefore be envisaged that this kind of plastic material will be very efficient for microfluidic devices in general when fluorescence measurements are relied upon. This is likely to be at hand also for microfluidic devices in form of discs as used in the present invention.

In each microchannel structure liquids are processed including that various chemical and/or biochemical reactions are taking place, often in order to carry out an assay protocol, an organo-chemical or biochemical synthesis protocol etc. Typical assay protocols utilize specific reactions between reactants having mutual affinity to each other leading to (a) formation of an affinity complex that is immobilized to a solid phase in a detection microcavity or (b) some other reaction product that may be soluble or insoluble in the detection microcavity. By properly arranging the reaction conditions including selection of

reactants, it can often be arranged so that the products obtained and/or excess reagents are analytically detectable with a signal that can be measured from the above-mentioned detector areas and related to features of a starting liquid aliquot that are unknow. Typical features are kind, form and amount including activity etc of a particular affinity reactant including an enzyme etc. The concept "feature" in this context also includes characterization how different reaction variables such as pH, ionic strength, detergents etc might influence the reaction used for forming the reaction product. Typically one makes use of detection principles based on radioactivity, fluorescence, chemiluminescence, bioluminescence, enzymatic activity, chromogens etc, for instance by utilizing reactants that exhibits groups providing the corresponding properties or groups that can be transformed to one of these groups. Typically this kind or reactants are incorporated into the complex to be measured or into some other reaction product. See for instance our copending application "Characterization of reaction variables influencing formation and/or dissociation of affinity complexes" filed on September 17, 2001 with Mats Inganäs, Per Andersson et al as inventors (this application is hereby incorporated by reference). The product, excess reagents etc that can be collected and measured in a microcavity are collectively called "substance" in other parts of this specification.

Typical reactants in this context are individual members of affinity pairs such as (a) antigen/hapten and the corresponding antibody including its antibody active fragments, (b) lectin and the corresponding carbohydrate structure, (c) native ligands and the corresponding receptors, (d) complementary nucleic acids including synthetic variants such as synthetic oligonucleotides, (e) Ig(Fc)-binding proteins and Protein A, Protein G and other Ig(Fc)-receptors, (e) ion pairs of opposite charges, enzyme and the substrate, inhibitor, cofactor, coenzyme etc that can bind to the enzyme, etc Synthetic variants more or less mimicking a native affinity interaction are also included.

The flow direction in a detection microcavity may be radially outwards or inwards, essentially parallel with the circumference of the disc including more or less straight flow, or any intermediary direction to these extremes. In most cases there are practical advantages in case the flow directions in all detection microcavities are the same relative the circumference. The plurality of detection microcavities and the corresponding detection areas are preferably arranged in subgroups such that all members of a subgroup are

positioned at the same radial distance and/or at the same angular position and/or have equal length and/or cross-sectional dimensions. Within each subgroup there may be at least two, three or more detection microcavities (detection areas), such as ≥ 10 or ≥ 25 or ≥ 50 detection microcavities(detection areas).

Different subgroups primarily differ with respect to radial distance from the axis of symmetry, direction relative the circumference, length and cross-sectional dimension. Different subgroups may occupy different sectors or define annular zones at different radial distances around the axis of symmetry, including segments of annular zones that are parallel with the circumference of the disc.

A detection area in the inventive arrangement typically has an area within the range of $1x10^2$ - $2x10^6$ μm^2, such as $1x10^3$ – 10^5 μm^2. Their length and/or breadth are typically within the range of 0.5x10 – $5x10^4$ μm, such as 1x10 –10^4 μm.

The experimental part of the above-mentioned US provisional application and SE application with Mats Inganäs and Per Andersson as inventors present results obtained with the present invention. The set up therein described also defines the best mode of the invention at the priority date.

The invention is defined in more detail in the appending claims

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CLAIMS

1. A detector detector arrangement that is adapted for measuring radiation from specific detector areas in a microfluidic device comprising

i) a disc with an axis of symmetry, and

ii) a plurality of microchannel structures, each of which have an inlet port, a detection microcavity and a microchannel connecting the inlet port with the detection microcavity, and

iii) a detection area which is associated with said detection microcavity in the surface of at least one of the two parallel sides of the disc, preferably with at least two or more of the detection microcavities being at the same radial distance and/or at the same angular position relative the axis of symmetry,

said arrangement comprising:

(a) at least one detector unit comprising a detector head (102), which is capable of collecting radiation from an area of predetermined size (focal point or focal area), said focal area defining the dimension of a subarea (34a) that is part of a detector area (35a) and said radiation emanating specifically from a substance that possibly is present in said subarea (34a), and

(b) means (means I) (103) for holding the disc and enabling for the detector head (102) to transverse several subareas (34a,b,c etc) that are positioned in an essentially circumferential direction in at least one of said one or more detection areas (35), and

(c) means (means II) (104) enabling for the detector head (102) to transverse subareas (34a',b',c' etc) that are positioned in the radial direction in at least one of said one or more detection areas (35), and

(d) means (means III) (105) for recognizing the angular positions for different parts of individual detection areas (35a',b',c' etc) and of their subareas, and

(e) means (means IV) (106) for recognizing the radial positions for different parts of individual detection areas and their subareas, and

(f) a controller (107), e.g. computer with software and electrical connections, that controls

(i) that means I (103) and II (104) cause the detector head (102) to transverse in an essentially circular fashion over the surface of at least one annular zone of the disc where there are detector areas (35a',b',c' etc) or over part of said annular zone

(ii) that the detector head (102) successively collects radiation from individual subareas or groups of subareas in a preselected manner.

2. The arrangement of claim 1, **characterized** in that the detector unit is based on laser induced fluorescence from the substance, preferably combined with a confocal technique.

3. The arrangement of any of claims 1-2, **characterized** in

(a) that the focal area of predetermined size has dimensions such that it only cover a selected number of the detector areas which are at the same angular position or only a radial part of an detector area and

(b) that means II is capable of moving the detector head in the radial direction in order to cover the remaining detector areas or remaining radial part of said detector area.

4. The arrangement of claim 3, **characterized** in that the detector head is capable of collecting radiation from every detector area positioned at the same angular position, and subareas in detector areas that are present at one and the same angular position, means II being at least partially inherent in the detector head.

5. The arrangement of any of claims 1-4, **characterized** in that the disc to be used has a home position, that means I preferably comprises a spinner in form of an encoder (means III) giving at least 1000 grades per revolution which are linked to angular positions on the disc relative to the home position, and that means II comprises a translation responder for moving the detector head in radial direction and an encoder (means IV) that is linked to the actual radial position of the detector head.

6. The arrangement of any of claims 1-5, **characterized** in that the disc is made of plastic material, such as black plastic material.

7. The arrangement of any of claims 1-6, **characterized** in that one or more of the detection microcavities are associated with a flow direction for a liquid that has passed or will pass through microcavity and in that this flow direction is essentially radial, essentially circumferential or has an intermediary direction.

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ABSTRACT

A detector arrangement that is adapted for measuring radiation from one or more detection areas (35a,b,c etc) in a microfluidic device (101). The arrangement comprises:

(a) at least one detector unit comprising a detector head (102), which is capable of collecting radiation from an area of predetermined size (focal point or focal area), said area defining the dimension of a subarea (34a) that is part of a detector area (35a) and said radiation emanating specifically from a substance that possibly is present in said subarea (34a), and

(b) means (means I) (103) for holding the disc and enabling for the detector head (102) to transverse several subareas (34a,b,c etc) that are positioned in an essentially circumferential direction in at least one of said one or more detection areas (35), and

(c) means (means II) (104) enabling for the detector head (102) to transverse subareas (34a',b',c' etc) that are positioned in the radial direction in at least one of said one or more detection areas (35), and

(d) means (means III) (105) for recognizing the angular positions for different parts of individual detection areas (35a',b',c' etc) and of their subareas, and

(e) means (means IV) (106) for recognizing the radial positions for different parts of individual detection areas and their subareas, and

(g) a controller (107), e.g. computer with software, that controls

(i) that means I (103) and II (104) cause the detector head (102) to transverse in an essentially circular fashion over the surface of at least one annular zone of the disc where there are detector areas (35a',b',c' etc) or over part of said annular zone

(ii) that the detector head (102) collects radiation from individual subareas or groups of subareas in a preselected manner.

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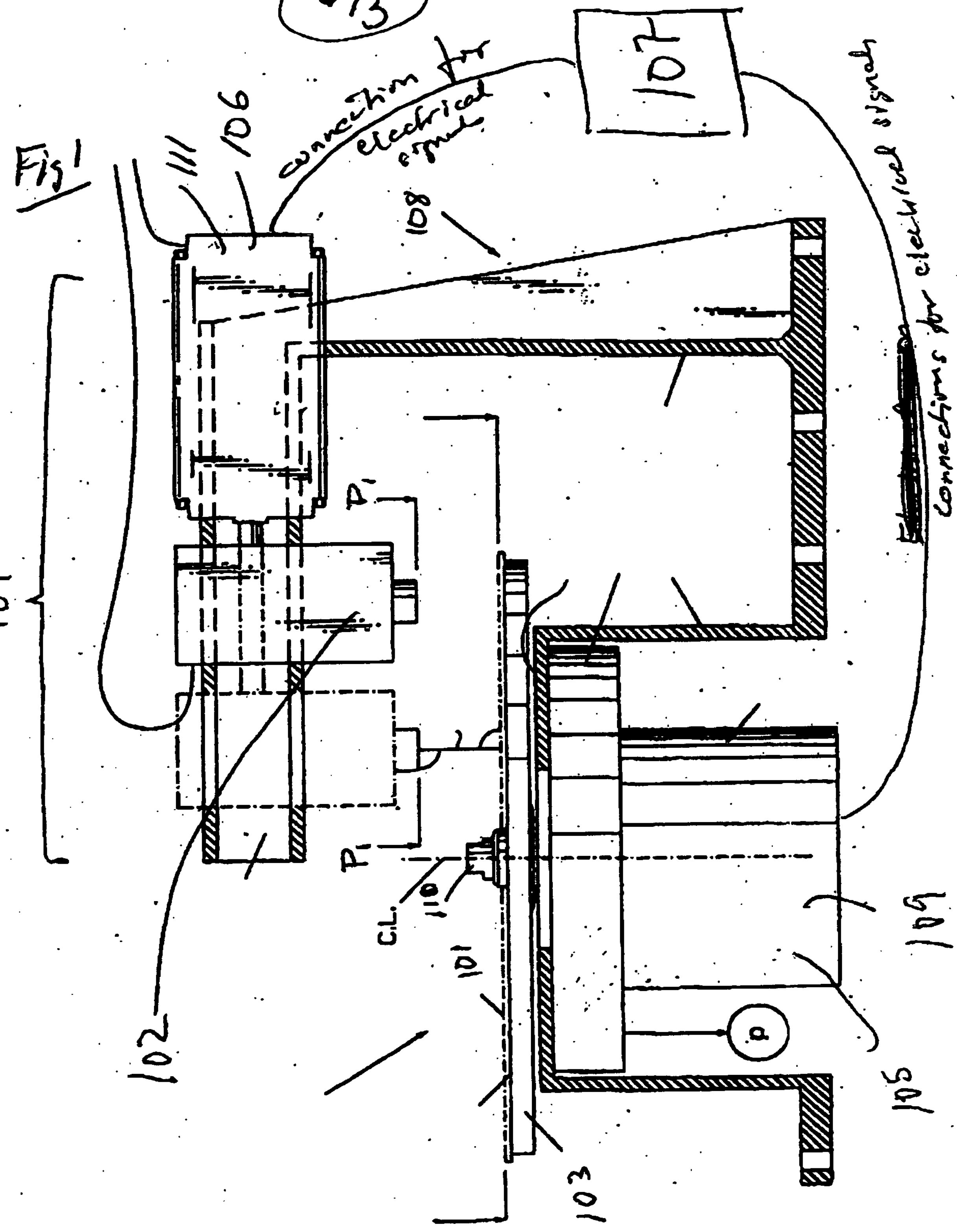
Fig 1
111
106
connection for electrical signals
107
108
104
102
P
P
C.L.
110
101
103
109
105
P
connections for electrical signals

2/3

Fig 2

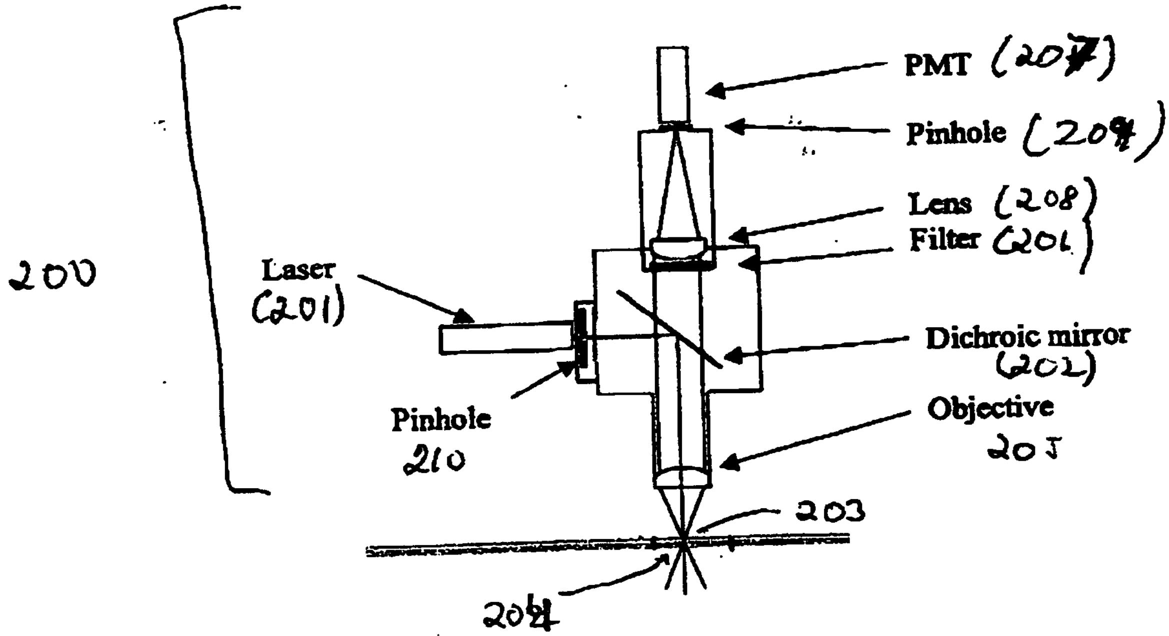
200
PMT (207)
Pinhole (209)
Lens (208)
Filter (206)
Laser (201)
Dichroic mirror (202)
Pinhole 210
Objective 205
203
204

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Fig 3a och b